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Survival, growth and production of *Penaeus monodon* at different stocking densities in earthen ponds with flow-through system and supplementary feeding

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Survival, growth and production of *Penaeus monodon* in earthen ponds were observed. Twelve 200 m^2 nursery ponds with water exchange rate of 5–10% daily were stocked with P_{53}-P_{54} prawn juveniles (0.45 g average weight) and reared for 3.5 months. Stocking density levels of 2.5, 5.0, 10 and 20 prawns/m^2 were designated as treatments A, B, C and D, respectively. Pelletized formula feed was given daily from second week of stocking at 10% of biomass and reduced bi-weekly by 1% to a final rate of 5% of biomass.

The overall average survival obtained was 92% with a mean range of 82.8 – 100%. Highest survival was achieved in treatment A, with 98.6%, followed by treatment B, 95.3%, treatment D, 87.6% and treatment C, 86.5% (Table 1).

Analysis of variance showed a significant effect of stocking density on survival rate of prawn at 5% level of significance. A further test of significance of the differences in survival means showed a highly significant differences between treatments A and C, A and D, B and C, and B and D. Although treatment A was higher than the others, the differences between them were not significant.

The final average weight obtained varied inversely with stocking density (Table 1). The highest mean weight (23.4 g) was achieved in treatment A and the lowest was in treatment D with (7.24 g). There were significant differences obtained among all paired means of the final weights except between treatment C and D.

Production per treatment varied directly with stocking density and survival rates. The highest extrapolated value of production in kg/ha/3.5 months was achieved in treatment D at a rate of 1,264.33 kg/ha followed by treatment C at 970.35 kg/ha; treatment B, 869.99 kg/ha; treatment A, 583.84 kg/ha. The size of harvested prawn is inversely related to production rates.

Table 2 shows the food conversion ratios. Food conversion rate was lowest with treatment A, 1.52; followed by treatment B, 1.71; treatment C, 2.08 and D, 2.56.

Table 1. Summary of stocking, harvest and production of *P. monodon* at four different stocking densities in earthen ponds with flow-through system and supplementary feeding.

Treatment (Stocking Density)	Pond No.	Stocking		Harvest		Production (kg/ha)	Survival %
		No.	Ave. wt. (g)	No.	Ave. wt. (g)		
A	5	500	0.45	494	20.14	497.50	98.8
(2.5/m^2)	10	500	0.45	500	24.43	632.79	100.0
	12	500	0.45	485	26.62	621.24	97.0
Average		500	0.45	493	23.40	583.84	98.6
B	3	1000	0.45	912	15.95	727.50	91.2
(5.0/m^2)	7	1000	0.45	966	21.87	1056.22	96.6
	9	1000	0.45	981	16.84	826.25	98.1
Average		1000	0.45	953	18.22	869.99	95.3
C	11	2000	0.45	1740	11.51	1001.37	87.0
(10/m^2)	13	2000	0.45	1729	10.98	949.65	86.5
	15	2000	0.45	1718	11.18	960.02	85.9
Average		2000	0.45	1729	11.22	970.35	86.5
D	4	4000	0.45	3310	7.75	1282.62	82.8
(20/m^2)	6	4000	0.45	3738	6.62	1237.28	93.5
	8	4000	0.45	3465	7.35	1273.39	86.6
Average		4000	0.45	3504	7.24	1264.33	87.6

Provision for a healthful pond environment was essential to the growth and survival of *P. monodon* stocked intensively in earthen ponds. This could be made possible through the use of a flow-through system, the type similar to prawn pond management that has been proven to give positive effects. Similar observations have been reported by other workers (Shigueno and Nakayama, 1974; Shigueno, 1975; Liao, 1976; Apud, 1979).

The type of flow-through operation and supplementary feeding used in this study have shown excellent survival rates. Although survival rate was high, other factors that will promote faster growth need to be determined. The quality and quantity of feed, improvement of water, management on the present flow-through system and better control of disease might lead to faster growth in a shorter period.

Table 2. Summary of pelletized formula feed consumed, total weight gain of prawn and feed conversion rate at four different stocking densities (A, 2.5/m^2; B, 5.0/m^2; C, 10/m^2 and D, 20/m^2) in earthen nursery ponds.

Treatment	Amount of feed consumed/treatment (g)	Total weight gain/treatment (kg)	Feed conversion rate
A	51.55	33.93	1.52
B	86.97	50.74	1.71
C	115.56	55.50	2.08
D	180.94	70.71	2.56

The presence of some natural food in the pond and their value as food to *P. monodon* could not be properly evaluated in this study. In view of this, the computed food conversion ratio based on the amount of feed given could not be solely attributed to supplementary feed. There is also that possibility of food competition due to the presence of gobies. Determination of stocked population was difficult. Feeding ration was adjusted on a plan based on certain assumptions. As stocking density increased, survival rate decreased and growth rate was lower in treatment C and D compared to treatment A and B. The feed was able to provide good growth in ponds with stocking density of 2.5 to 5.0 per m^2. The amount and quality of food were adequate for survival but were probably not the most suitable for promoting faster growth when ponds are stocked with *P. monodon* at higher densities.

The high survival attained in the present study was relatively higher than the reported 75% survival of *P. monodon* in concrete tanks (Liao, 1977) and comparable to that achieved in Japan (80-100%) using 1.1 g *P. japonicus* juveniles (Shigueno and Nakayama, 1974). On the other hand, growth rates of *P. monodon* were lower compared to that obtained from a sufficiently renewed and aerated concrete tank (10 x 20 x 1.5 m) as reported by Liao (1977). A similar problem of slow growth rate was also observed by Shigueno (1975) in *P. japonicus*. He emphasized that the larger the amount of renewed water, the better was the growth rate. Probably, the level of water renewal that brought higher survival in this experiment was not necessarily the level that favored the growth of *P. monodon*. The optimum water management scheme level for the growth of *P. monodon* at various stocking densities has yet to be determined.

A dull coloration of prawns characterized by tiny brownish projections when viewed underwater was also observed in two ponds. A microscopic examination revealed the presence of *Vorticella*. The parts of the body which showed prominent infection were the pleopods, tailparts and carapace. The attack however, did not cause mass mortality. Common diseases affecting shrimp were described by Shigueno (1975) and Liao (1977). None of them, however, mentioned

Vorticella as a causative agent infecting prawns. Prawns affected by *Vorticella* had inhibited molting and were soft bodied and sluggish. A case of *Vorticella* seriously attacking zoeal and mysis stages of *P. monodon* in the hatchery was reported by Gacutan, *et al.* (1977). No specific treatment applicable to earthen ponds was found, but maintenance of a clean water environment is recommended as a preventive measure against its possible attack.

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